

SHEET TRANSPORTING DEVICE AND IMAGE FORMING APPARATUS AND
ASSEMBLING METHOD FOR IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sheet transporting device for transporting a sheet and an image forming apparatus for forming an image on the sheet.

Description of the Related Art

An image forming apparatus generally includes an image forming part and a sheet transporting part for transporting a sheet to the image forming part, and the image forming part and the sheet transporting part are housed in an image forming apparatus main body. In the image forming apparatus as stated above, in order to form images on both sides of the sheet, the sheet on the surface of which an image is formed is reversed, the sheet is again transported to the image forming part, and an image is formed on the back side.

Conventionally, as this kind of image forming apparatus, it is well known that a sheet reversing device is attached to an image forming apparatus main body, so that a sheet is reversed, and two-sided printing is performed (see patent document 1).

[Patent document 1] JP-A-10-129912

However, when a sheet transporting passage is formed in a sheet transporting device, there is a case where the sheet

transporting device can not be miniaturized.

Besides, when the sheet transporting passage is formed in the sheet transporting device, in a case where the sheet transporting device is attached around the image forming apparatus main body, there is a case where the image forming apparatus can not be miniaturized.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above circumstances and provides a sheet transporting device which is miniaturized. Besides, the present invention provides an image forming apparatus including a sheet transporting device, which is miniaturized.

According to an aspect of the present invention, a sheet transporting device includes an enclosure including a first guide part at least a part of which can be exposed to outside, wherein another sheet transporting device is attached to the enclosure, the another sheet transporting device includes a second guide part at least a part of which is exposed to outside, and at least a part of a sheet transporting passage includes the first guide part and the second guide part. Accordingly, even if at least the part of the sheet transporting passage is not included in the another sheet transporting device to be attached to the enclosure, when the another sheet transporting device is attached to the enclosure, the sheet transporting

passage is constructed, and accordingly, the enclosure of the sheet transporting device and the another sheet transporting device can be miniaturized.

According to another aspect of the present invention, a sheet transporting device includes a first guide part at least a part of which can be exposed to outside, and a second guide part at least a part of which is exposed to outside and which is provided in an enclosure to be attached, wherein at least a part of a sheet transporting passage includes the first guide part and the second guide part. Accordingly, even if at least the part of the sheet transporting passage is not included in the enclosure, when the another sheet transporting device is attached to the enclosure, the sheet transporting passage is constructed, and accordingly, the enclosure of the sheet transporting device and the another sheet transporting device can be miniaturized.

According to another aspect of the present invention, a sheet transporting device includes an enclosure including a first guide part at least a part of which can be exposed to outside, and another sheet transporting device to be attached to the enclosure, wherein the another sheet transporting device includes a second guide part at least a part of which is exposed to outside, and at least a part of a sheet transporting passage includes the first guide part and the second guide part. Accordingly, even if at least the part of the sheet transporting

passage is not included in the enclosure and the another sheet transporting device, when the another sheet transporting device is attached to the enclosure, the sheet transporting passage is constructed, and accordingly, the sheet transporting device can be miniaturized.

According to another aspect of the present invention, an image forming apparatus includes an enclosure including a first guide part at least a part of which can be exposed to outside, wherein a sheet transporting device is attached to the enclosure, the sheet transporting device includes a second guide part at least a part of which is exposed to outside, and at least a part of a sheet transporting passage includes the first guide part and the second guide part. Accordingly, even if at least the part of the sheet transporting passage is not included in the sheet transporting device to be attached to the enclosure, when the another sheet transporting device is attached to the enclosure, the sheet transporting passage is constructed, and accordingly, the image forming apparatus and the sheet transporting device can be miniaturized.

According to another aspect of the present invention, an image forming apparatus includes an enclosure including a first guide part at least a part of which can be exposed to outside, and a sheet transporting device to be attached to the enclosure, wherein the sheet transporting device includes a second guide part at least a part of which is exposed to outside,

and at least a part of a sheet transporting passage includes the first guide part and the second guide part. Accordingly, even if at least the part of the sheet transporting passage is not included in the enclosure and the sheet transporting device, when the sheet transporting device is attached to the enclosure, the sheet transporting passage is constructed, and accordingly, the image forming apparatus and the sheet transporting device can be miniaturized.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention will be described in detail based on the following figures, wherein:

Fig. 1 is a side view showing an image forming apparatus according to a first embodiment of the invention;

Fig. 2 is a side view showing an image forming apparatus in which a two-sided unit is attached to the image forming apparatus according to the first embodiment of the invention;

Fig. 3 is a perspective view showing the outside of the two-sided unit to be attached to the image forming apparatus according to the first embodiment of the invention;

Fig. 4 is a perspective view showing the inside of the two-sided unit to be attached to the image forming apparatus according to the first embodiment of the invention;

Fig. 5 is a perspective view showing a state in which a two-sided unit opening/closing part of the two-sided unit

to be attached to the image forming apparatus according to the first embodiment of the invention is opened;

Fig. 6 is a perspective view showing a state in which a unit cover and the two-sided unit opening/closing part of the two-sided unit to be attached to the image forming apparatus according to the first embodiment of the invention are opened;

Fig. 7 is a side view showing the two-sided unit to be attached to the image forming apparatus according to the first embodiment of the invention;

Fig. 8 is a perspective view showing a fixing unit of the image forming apparatus according to the first embodiment of the invention;

Fig. 9 is a side view showing an image forming apparatus according to a second embodiment of the invention;

Fig. 10 is a side view showing a method of attaching sheet supply units 168 and 170 to the image forming apparatus according to the second embodiment of the invention; and

Fig. 11 is a side view showing a state in which the sheet supply units 168 and 170 are attached to the image forming apparatus according to the second embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

A first embodiment of the present invention will be described with reference to the drawings.

Fig. 1 shows the outline of an image forming apparatus

10 according to the first embodiment of the invention. The image forming apparatus 10 of the first embodiment includes an image forming apparatus main body 12, a detachable cover 13 provided at an upper part of the image forming apparatus main body 12, and a passing port 14, through which a sheet passes, provided at a lower part of a back side (right side of Fig. 1) of the image forming apparatus main body 12. Besides, an opening/closing cover 16 rotatable around a rotation fulcrum 15 is provided at the upper part of the image forming apparatus main body 12, and for example, a one-stage sheet supply unit 18 is disposed at the lower part of the image forming apparatus main body 12.

The sheet supply unit 18 includes a sheet supply unit main body 20 and a sheet supply cassette 22 in which sheets are stored. A feed roll 24 for feeding sheets from the sheet supply cassette 22 and a retard roll 26 for separating the fed sheets from each other one by one are disposed at an upper part in the vicinity of a back end of the sheet supply cassette 22.

A transporting passage 28 is a sheet passage from the feed roll 24 to an ejection port 30, and this transporting passage 28 is substantially vertically formed in the vicinity of the back side (right side of Fig. 1) of the image forming apparatus main body 12 and from the sheet supply unit 18 to an after-mentioned fixing device 90. A secondary transfer roll 80 and a secondary transfer backup roll 72 described later are

disposed at the upstream side of the fixing device 90 in the transporting passage 28, and a registration roll 32 is disposed at the upstream side of the secondary transfer roll 80 and the secondary transfer backup roll 72. Besides, an ejection roll 34 is disposed in the vicinity of the ejection port 30 of the transporting passage 28.

Accordingly, the sheets sent out from the sheet supply cassette 22 of the sheet supply unit 18 by the feed roll 24 are separated from each other by the retard roll 26 so that only the uppermost sheet is guided to the transporting passage 28, the sheet is temporarily stopped by the registration roll 32, a toner image is transferred at a suitable timing through between the secondary transfer roll 80 and the secondary transfer backup roll 72, the transferred toner image is fixed by the fixing device 90, and the sheet is ejected by the ejection roll 34 from the ejection port 30 to an ejection part 36 provided at the upper part of the opening/closing cover 16. The ejection part 36 is inclined so that the portion of the ejection port is low and it gradually becomes high toward the front direction (left direction of Fig. 1).

A rotary developer unit 38 is disposed at, for example, the substantially center part of the image forming apparatus main body 12. The rotary developer unit 38 includes, in a developer unit main body 40, developer units 42a to 42d for respectively forming four color toner images of yellow, magenta,

cyan and black, and rotates in a left-handed direction (counterclockwise direction in Fig. 1) around a rotary developer unit center 44. The respective developer units 42a to 42d include development rolls 46a to 46d, and are pressed in the normal direction of the developer unit main body 40 by elastic bodies 48a to 48d such as, for example, coil springs.

An image supporting body 50 made of, for example, a photosensitive body is disposed to come in contact with the rotary developer unit 38, and in a state where the development rolls 46a to 46d are not in contact with the image supporting body 50, a part of the outer circumference of each of them protrudes from the outer periphery of the developer unit main body 40 by, for example, 2 mm in a radius direction. Besides, at both ends of the respective development rolls 46a to 46d, tracking rolls (not shown) having diameters slightly larger than the diameters of the development rolls 46a to 46d are provided so as to rotate coaxially with the development rolls 46a to 46d. That is, the development rolls 46a to 46d of the developer units 42a to 42d are disposed at the outside of the developer unit main body 40 at intervals of 90° around the rotary developer unit center 44, the tracking rolls of the development rolls 46a to 46d come in contact with flanges (not shown) provided at both ends of the image supporting body 50, and a latent image on the image supporting body 50 is developed with toners of the respective colors while predetermined gaps are formed

between the development rolls 46a to 46d and the image supporting body 50.

A charging device 52 made of, for example, a charging roll and for uniformly charging the image supporting body 50 is provided below the image supporting body 50. Besides, an image supporting body cleaner 54 is in contact with the image supporting body 50 at the upstream side of the charging device 52 in the rotation direction of the image supporting body 50. The image supporting body cleaner 54 is constructed of a cleaning blade 56 for scraping away the toner remaining on the image supporting body 50 after primary transfer and a toner collection bottle 58 for collecting the toner scraped away by the cleaning blade 56.

Incidentally, for example, a rib or the like is formed at the back side (right side in Fig. 1) of the toner collection bottle 58, the back side is made a curved surface so that a sheet is smoothly transported, and it constitutes the transporting passage 28.

An exposure device 60 for writing a latent image by a light beam, such as a laser beam, to the image supporting body 50 charged by the charging device 52 is disposed below the rotary developer unit 38. Besides, an intermediate transfer device 62 for primarily transferring the toner image visualized by the rotary developer unit 38 at a primary transfer position and transporting it to an after-mentioned secondary transfer

position is provided above the rotary developer unit 38.

The intermediate transfer device 62 is constructed of, for example, an intermediate transfer body 64 such as an intermediate transfer belt, a primary transfer roll 66, a lap-in roll 68, a lap-out roll 70, a secondary transfer backup roll 72, a scraper backup roll 74, and a brush backup roll 76. The intermediate transfer body 64 has, for example, elasticity, and is stretched to be substantially flat so as to have a long side and a short side above the rotary developer unit 38. Besides, the intermediate transfer body 64 includes an image supporting body lap area coming in contact with the image supporting body 50 in a lap state between the lap-in roll 68 disposed below the long side of the intermediate transfer body 64 and at the upstream side of the primary transfer roll 66 and the lap-out roll 70 disposed at the downstream side of the primary transfer roll 66, and winds around the image supporting body 50 in a predetermined range to follow the rotation of the image supporting body 50. As stated above, the intermediate transfer body 64 repeatedly primarily transfers the toner image on the image supporting body 50 by the primary transfer roll 66 in the sequence of, for example, yellow, magenta, cyan and black, and transports the primarily transferred toner image to the secondary transfer roll 80 described later.

Incidentally, the lap-in roll 68 and the lap-out roll 70 are separated from the image supporting body 50.

Further, a plane part (short side) is formed at the back side (right side of Fig. 1) of the intermediate transfer body 64 by the lap-out roll 70 and the secondary transfer backup roll 72, and this plane part becomes a secondary transfer part and faces the transporting passage 28.

Incidentally, the lap-out roll 70 is disposed so that an angle between the intermediate transfer body 64 and the transporting passage 28 becomes, for example, 12° at the secondary transfer part.

The scraper backup roll 74 assists an after-mentioned scraper 84 to scrape away the toner remaining on the intermediate transfer body 64 after the secondary transfer, and the brush backup roll 76 assists an after-mentioned brush roll 86 to scrape away the toner remaining on the intermediate transfer body 64 after the secondary transfer.

A sensor 78 such as, for example, a reflection type photosensor is fixed to the back side (inside) of the opening/closing cover 14 and is provided above the long side of the intermediate transfer body 64. The sensor 78 reads out a patch of the toner formed on the intermediate transfer body 64, detects the position of the intermediate transfer body 64 in the rotation direction, and detects the concentration of the toner.

The secondary transfer roll 80 faces the secondary backup roll 72 of the intermediate transfer device 62 through the

transporting passage 28. That is, a position between the secondary transfer roll 80 and the secondary transfer backup roll 72 is a secondary transfer position in the secondary transfer part, and the secondary transfer roll 80 secondarily transfers the toner image, which is primarily transferred to the intermediate transfer body 64, to the sheet at the secondary transfer position by the assistance of the secondary transfer backup roll 72. Here, the secondary transfer roll 80 is separated from the intermediate transfer body 64 while the intermediate transfer body 64 is rotated three times, that is, the toner images of three colors of yellow, magenta and cyan are transported, and when the toner image of black is transferred, the secondary transfer roll comes in contact with the intermediate transfer body 64. Incidentally, a predetermined potential difference is generated between the secondary transfer roll 80 and the secondary transfer backup roll 72, and for example, in the case where the secondary transfer roll 80 is made to have a high voltage, the secondary transfer backup roll 72 is connected to the ground (GND) or the like.

An intermediate transfer body cleaner 82 is in contact with the intermediate transfer device 62 at the side opposite to the secondary transfer position. The intermediate transfer cleaner 82 is constructed of the scraper 84 for scraping away the toner remaining on the intermediate transfer body 64 after the secondary transfer and cleaning it, the brush roll 86 for

further scraping away the toner remaining after the cleaning by the scraper 84, and a toner collection bottle 88 for collecting the toner scraped away by the scraper 84 and the brush roll 86. The scraper 84 is made of, for example, a thin plate of stainless, and a predetermined voltage is applied. The brush roll 86 is made of, for example, a brush of acryl or the like subjected to conductivity processing. Besides, during the period when the intermediate transfer body 64 transports the toner image, the scraper 84 and the brush roll 86 are separated from the intermediate transfer body 64, and these become one body and come in contact with the intermediate transfer body 64 at a predetermined timing.

The fixing device 90 is disposed above the secondary transfer position. The fixing device 90 includes a heat roll 92 and a pressure roll 94, fixes the toner image, which is secondarily transferred to the sheet by the secondary transfer roll 80 and the secondary transfer backup roll 72, to the sheet, and transports it to the ejection roll 34. A fixing unit 95 is such that the fixing device 90 and the ejection roll 34 are integrated. When the cover 13 is removed from the image forming apparatus main body 12, the back side (right side in Fig. 1) of the fixing unit 95 is exposed.

An image forming unit 96 is such that the intermediate transfer device 62, the image supporting body 50, the charging device 52, the image supporting body cleaner 54 and the

intermediate transfer body cleaner 82 are integrated. The image forming unit 96 is disposed immediately below the ejection part 36 of the opening/closing cover 16, and for example, the intermediate transfer device 62 is disposed between the rotary developer unit 38 and the fixing device 90, and the image forming unit is detached/attached by opening the opening/closing cover 16.

Fig. 2 shows an image forming apparatus 100 in which a two-sided unit 98 is attached to the image forming apparatus 10 of the first embodiment of the invention.

The two-sided unit 98 includes a two-sided unit main body 102 and a detachable unit cover 104 at an upper part of the two-sided unit main body 102, and is attached to the front side upper part of the image forming apparatus main body 12 after the cover 13 is removed from the image forming apparatus main body 12.

In the two-sided unit body 102, a reversal roll 106 is provided at the upper front side (left side of Fig. 2). The reversal roll 106 is disposed above the ejection roll 34 and so as to protrude toward the front side. That is, the reversal roll 106 is disposed at a position more distant from the fixing device 90 than the ejection roll 34. Besides, the reversal roll 106 holds the sheet at pressure higher than the ejection roll 34, and is forward and backward rotated by a reversing motor 108 through after-mentioned gears 136a to 136d. A

reversal transporting passage 110 is a sheet passage from the reversal roll 106 to the registration roll 32 through the passing port 14, and the reversal transporting passage 110 includes a portion formed above the fixing unit 95 and a portion formed substantially vertically at the front outside of the image forming apparatus 10. In the reversal transporting passage 110, a transporting passage changeover plate 112 is provided in the vicinity of the ejection roll 34. The transporting passage changeover plate 112 is changed so that the sheet on which the toner image is fixed by the fixing device 90 is guided toward either the ejection roll 34 or the reversal roll 106. Transport rolls 114 and 116 are disposed at the downstream side of the transporting passage changeover plate 112 in the reversal transporting passage 110. A transporting motor 118 drives the transport rolls 114 and 116 independently from the reversal roll 106.

Accordingly, in the case where two-sided printing is performed, the sheet guided to the reversal roll 106 side by the transporting passage changeover plate 112 is sent out to the front side of the image forming apparatus 10 by the reversal roll 106 until the rear end of the sheet is sent out from the fixing device 90, and when the rear end of the sheet is sent out from the fixing device 90, the reversal roll 106 is reversed, and the sheet is guided to the transport roll 114. The sheet guided to the transport roll 114 is again returned to the

registration roll 32 through the transport roll 116 and the passing port 14. The sheet is temporarily stopped by the registration roll 32, a toner image is transferred at a suitable timing, the transferred toner image is fixed by the fixing device 90, the sheet is guided to the transporting passage changeover plate 112, and is ejected by the reversal roll 106 to the ejection part 36 provided at the upper part of the opening/closing cover 16.

As stated above, when the two-sided unit 98 as an option is attached, the image forming apparatus 10 constitutes the image forming apparatus which can perform two-sided printing.

Incidentally, in the case where the sheet is ejected to the ejection part 36, the transporting passage changeover plate 112 may be changed so that the sheet is ejected from either the ejection roll 34 or the reversal roll 106.

Next, the two-sided unit 98 will be described in detail.

Fig. 3 is a perspective view showing the outside of the two-sided unit 98. The two-sided unit 98 includes the two-sided unit main body 102 as described above, and the detachable unit cover 104 is provided at the upper part of the two-sided unit main body 102. A two-sided unit opening/closing part 120 is provided at the outside (Fig. 3) of the two-sided unit main body 102, and a vertical portion of the reversal transporting passage 110 is opened and closed. Fig. 4 is a perspective view showing the inside (attachment surface facing the image forming

apparatus main body 12) of the two-sided unit 98. An after-mentioned upper outside guide 130 is exposed at the inside of the two-sided unit 98.

Figs. 5 to 7 show the structure of the two-sided unit 98 in the vicinity of the reversal transporting passage 110. The reversal transporting passage 110 includes an outside guide part 122 for guiding the sheet at the outside of the two-sided unit 98 and an inside guide part 124 for guiding the sheet at the inside of the two-sided unit 98. The outside guide part 122 is constructed of, for example, a rib-shaped outside guide 126 provided in the two-sided unit opening/closing part 120, a rib-shaped lower outside guide 128 provided in the two-sided unit main body 102, and a rib-shaped upper outside guide 130 detachably provided below the unit cover 104. The inside guide part 124 is constructed of an inside guide 132, which substantially faces the outside guide 126 and the lower outside guide 128 and is provided in the two-sided unit main body 102, and an upper inside guide 134 for guiding the sheet from below in the vicinity of the reversal roll 106.

The transport rolls 114 and 116 transport the sheet between the outside guide 126 and the inside guide 132. Besides, as shown in Fig. 6, the reversal rolls 106 are provided at, for example, four places, and are forward and backward rotated by the reversing motor 108 through the gears 136a to 136d disposed above the two-sided unit main body 102.

As shown in Fig. 4 as well, in the two-sided unit 98, the lower surface of the upper outside guide 130 is exposed to the reversal transporting passage 110. That is, a portion between the inside guide 132 and the upper inside guide 134 is opened at the lower surface of the upper part of the two-sided unit 98.

Fig. 8 is a perspective view showing the outer shape of the fixing unit 95. The fixing unit 95 includes a fixing device housing part 138 for housing the heat roll 92, the pressure roll 94 and the like, and an ejection roll housing part 140 for housing the ejection roll 34. Besides, for example, a rib-shaped outside guide 142 is provided at the upper surface of the fixing unit 95, a changeover plate hole 144 in which the transporting passage changeover plate 112 of the two-sided unit 98 is inserted is provided between the fixing device housing part 138 and the ejection roll housing part 140.

When the two-sided unit 98 is attached to the fixing unit 95 at the upper part of the image forming apparatus main body 12, the outside guide 142 of the fixing unit 95 is disposed at the opened portion between the inside guide 132 and the upper inside guide 134. That is, when the cover 13 is removed from the image forming apparatus main body 12, and the two-sided unit 98 is attached to the upper part of the image forming apparatus main body 12, the outside guide 142 of the fixing unit 95 is disposed between the inside guide 132 and the upper

inside guide 134, and the reversal transporting passage 110 is constructed (see Figs. 2, 6 and 7).

Next, a description will be given to the operation of the image forming apparatus 10 to which the two-sided unit 98 is attached.

When an image forming signal is sent, the image supporting body 50 is uniformly charged by the charging device 52, and a light beam is irradiated from the exposure device 60 to the charged image supporting body 50 on the basis of the image signal. The light beam from the exposure device 60 exposes the surface of the image supporting body 50, and a latent image is formed. The latent image of the image supporting body 50 formed by the exposure device 60 is developed by the rotary developer unit 38 to form yellow, magenta, cyan and black toner images, and they are overlapped with the intermediate transfer body 64 and are primarily transferred. At the primary transfer, the waste toner remaining on the image supporting body 50 is scraped away by the image supporting body cleaner 54 and is collected.

On the other hand, on the basis of a sheet supply signal or the like, a sheet stored in the sheet supply cassette 22 is sent out by the feed roll 24, is separated by the retard roll 26 and is guided to the transporting passage 28, is temporarily stopped by the registration roll 32, and is guided to a place between the secondary transfer roll 80 and the secondary transfer backup roll 72 at a suitable timing. When

the sheet is guided to the place between the secondary transfer roll 80 and the secondary transfer backup roll 72, the toner image primarily transferred to the intermediate transfer body 64 is secondarily transferred to the sheet by the secondary transfer roll 80 and the secondary transfer backup roll 72. After the secondary transfer, the waste toner remaining on the intermediate transfer body 64 is scraped away by the intermediate transfer body cleaner 82 and is collected.

The sheet to which the toner image is transferred is guided to the fixing device 90, and the toner image is fixed through heat and pressure by the heat roll 92 and the pressure roll 94. The sheet on which the toner image is fixed is guided to the transporting passage changeover plate 112 and is guided to the reversal roll 106. The sheet guided to the reversal roll 106 is sent out toward the front side of the image forming apparatus 10 by the reversal roll 106 until the rear end of the sheet is sent out from the fixing device 90, and when the rear end of the sheet is sent out from the fixing device 90, the reversal roll 106 is reversed, the sheet is guided to the reversal transporting passage 110 and is guided toward the transport roll 114. The transport rolls 114 and 116 transport the sheet downward, and again guide it to the registration roll 32. The toner image is again transferred to the sheet guided to the registration roll 32, and the sheet is guided to transporting passage changeover plate 112 through the fixing

device 90, and is ejected to the ejection part 36 by the reversal roll 106.

Incidentally, in the case where the two-sided unit 98 is not attached, the image forming apparatus 10 ejects the sheet on which the toner image is fixed to the ejection part 36 from the ejection port 30 by the ejection roll 34.

Next, a second embodiment of the invention will be described with reference to the drawings.

Fig. 9 shows the outline of an image forming apparatus 10 according to the second embodiment of the invention.

Incidentally, in the image forming apparatus 10 of the second embodiment, substantially the same parts as those of the image forming apparatus 10 of the first embodiment are denoted by the same reference numerals.

In the image forming apparatus 10 of the second embodiment, a transport part 148 rotatable around a rotation fulcrum 146 is provided at an upper part of an image forming apparatus main body 12. Besides, a manual bypass tray 152 rotatable around a rotation fulcrum 150 is provided at the side opposite to the rotation fulcrum of the transport part 148. A pickup roll 154 for supplying a sheet from the manual bypass tray 152 is disposed at the transport part 148 side of the manual bypass tray 152.

A back side cover 156 is detachably provided at the lower part of the back side (right side of Fig. 9) of the image forming apparatus main body 12, and for example, after-mentioned sheet

supply units 168 and 170 as an option are attached.

A transporting passage 28 is a sheet passage from the pickup roll 154 to an ejection roll 34, and the transporting passage 28 is formed above the image forming apparatus main body 12 substantially horizontally from the manual bypass tray 152 to a fixing device 90. A secondary transfer roll 80 and a secondary transfer backup roll 72 are disposed at the upstream side of the fixing device 90 in the transporting passage 28, and a registration roll 32 is disposed at the upstream side of the secondary transfer roll 80 and the secondary transfer backup roll 72.

Accordingly, only the uppermost sheet of sheets sent out from the manual bypass tray 152 by the pickup roll 154 is guided to the transporting passage 28 and is temporarily stopped by the registration roll 32, a toner image is transferred through between the secondary transfer roll 80 and the secondary transfer backup roll 72 at a suitable timing, the transferred toner image is fixed by the fixing device 90, and the sheet is ejected to an ejection part 36. The ejection part 36 is inclined so that a portion at an ejection port is low and it gradually becomes high toward the front direction (left direction of Fig. 9).

In the image forming apparatus main body 12, a rotary developer unit 38 is disposed at, for example, the substantially center low part. An image supporting body 50 is disposed to come in contact with the rotary developer unit 38, and a charging

device 52 made of, for example, a charging roll and for uniformly charging the image supporting body 50 is provided at the back side (right side of Fig. 9) of the image supporting body 50. Besides, an image supporting body cleaner 54 is in contact with the image supporting body 50 at the upstream side of the charging device 52 in the rotation direction of the image supporting body 50. The image supporting body cleaner 54 is constructed of a cleaning blade 56 for scraping away the toner remaining on the image supporting body 50 after primary transfer and a toner collection bottle 58 for collecting the toner scraped away by the cleaning blade 56.

Incidentally, for example, a rib or the like is formed on the back side (right side in Fig. 9) of the toner collection bottle 58, and the back side is made a curved surface so that the sheet is smoothly transported, and constitutes the transporting passage 28.

An exposure device 60 for writing a latent image by a light beam, such as laser light, to the image supporting body 50 charged by the charging device 52 is disposed at the back side (right side of Fig. 9) of the rotary developer unit 38. Besides, an intermediate transfer device 62 for primarily transferring a toner image visualized by the rotary developer unit 38 at a primary transfer position and transporting it to a secondary transfer position is provided above the image supporting body 50.

The intermediate transfer device 62 of the second embodiment is constructed of, for example, an intermediate transfer body 64 such as an intermediate transfer belt, a primary transfer roll 66, a lap-in roll 68, a lap-out roll 70, the secondary transfer backup roll 72, and a belt cleaner backup roll 158. The intermediate transfer body 64 has, for example, elasticity, and is stretched to be substantially flat so that it has a long side and a short side above the image supporting body 50.

The belt cleaner backup roll 158 assists the transfer of the toner remaining on the intermediate transfer body 64 after secondary transfer to an after-mentioned belt cleaner roll 132. An intermediate transfer body cleaner 82 is in contact with the intermediate transfer device 62 at the side opposite to the secondary transfer position. The intermediate transfer body cleaner 82 is constructed of, for example, a brush roll 86 for scraping away the toner remaining on the intermediate transfer body 64 after the secondary transfer, a belt cleaner roll 160 for carrying out cleaning by further transferring the toner remaining after the brush roll 86 scrapes, a scraper 162 for scraping away the toner transferred to the belt cleaner roll 160, and a toner collection bottle 88 for collecting the scraped toner.

Besides, the fixing device 90 is disposed above the intermediate transfer device 62 and at the downstream side of

the secondary transfer position.

A power source part 164 is disposed in the vicinity of the front side (left side of Fig. 9) of the image forming apparatus main body 12, and supplies power to the respective portions constituting the image forming apparatus 10.

A control part 166 for controlling the respective portions constituting the image forming apparatus 10 is disposed above the power source part 164.

An image forming unit 96 is such that the intermediate transfer device 62, the image supporting body 50, the charging device 52, the image supporting body cleaner 54 and the intermediate transfer body cleaner 82 are integrated. The image forming unit 96 is disposed between the fixing device 90 and the rotary developer unit 38, and is attached/detached by opening the transport part 148.

Next, a description will be given to a method of constructing a sheet transporting passage by attaching sheet supply units 168 and 170 as an option.

Fig. 10 shows the sheet supply units 168 and 170 as the option and a method of attaching the sheet supply units 168 and 170 to the image forming apparatus 10. The sheet supply unit 168 includes a sheet supply unit main body 20 and a sheet supply cassette 22 in which sheets are stored. A pickup roll 172 for supplying sheets from the sheet supply cassette 22 is disposed at an upper part in the vicinity of a back end of the

sheet supply cassette 22 of the sheet supply unit 168. A unit transport guide part 174 is substantially vertically provided at the back side (right side in Fig. 10) of the pickup roll 172. A unit guide 176 formed to have, for example, a rib shape is exposed at the inside (left side in Fig. 10) of the unit transport guide part 174, and transport rolls 178a and 180a are provided. The transport rolls 178a and 180a, together with after-mentioned transport rolls 178b and 180b, are rotated to transport the sheet from a lower part to an upper part. Besides, a sheet passing port 182 is provided below the transport rolls 178a and 180a and at the lower surface of the sheet supply unit 168.

The sheet supply unit 170 includes a sheet supply unit main body 20 and a sheet supply cassette 22 in which sheets are stored. A pickup roll 184 for supplying the sheets from the sheet supply cassette 22 is disposed at an upper part of the back side of the sheet supply cassette 22 of the sheet supply unit 170, and a feed roll 24 and a retard roll 26 for separating the supplied sheets from each other one by one are disposed above the vicinity of the back end of the sheet supply cassette 22. Besides, a sheet passing roll 186 is provided in the vicinity of the feed roll 24 and the retard roll 26 and above the sheet supply unit 170.

When the back cover 156 is removed from the image forming apparatus main body 12, a main body back surface 188 formed

to have, for example, a rib shape and a sheet passing port 190 disposed above the main body back surface 188 are exposed. The transport rolls 178b and 180b are rotatably attached to the main body back surface 188. The sheet supply units 168 and 170 are piled up while the sheet passing ports 182 and 186 are made to face each other, and are attached so that the upper surface of the sheet supply unit 168 comes in contact with the lower surface of the image forming apparatus main body 12. When the sheet supply units 168 and 170 are attached to the lower part of the image forming apparatus main body 12, the unit guide 176 of the sheet supply unit 168 faces the main body back surface 188. Besides, the transport rolls 178a and 180a come in contact with the transport rolls 178b and 180b attached to the main body back surface 188.

Accordingly, as shown in Fig. 11 as well, when the sheet supply unit 168 is attached to the image forming apparatus main body 12, the main body back surface 188 and the unit guide 176 become a guide for guiding the sheet, and a sheet transporting passage 192 is constructed from the pickup roll 172 to the registration roll 32 through the transport rolls 178a, 178b, 180a and 180b, and the sheet passing port 190. Besides, the sheet supply units 168 and 170 are piled up and attached while the sheet passing ports 182 and 186 are made to face each other, so that the sheet sent out from the sheet supply unit 170 is guided to a sheet transporting passage 192 through the sheet

passing ports 182 and 186.

Next, a description will be given to the operation of the image forming apparatus in which the sheet supply units 168 and 170 are attached to the image forming apparatus 10 of the second embodiment.

When an image forming signal is sent from the control part 166, the image supporting body 50 is uniformly charged by the charging device 52, and a light beam is irradiated to the charged image supporting body 50 from the exposure device 60 on the basis of the image signal. The light beam from the exposure device 60 exposes the surface of the image supporting body 50, and a latent image is formed. The latent image of the image supporting body 50 formed by the exposure device 60 is developed by the rotary developer unit 38 to form yellow, magenta, cyan and black toner images, and they are overlapped with the intermediate transfer body 64 and are primarily transferred. At the primary transfer, the waste toner remaining on the image supporting body 50 is scraped away by the image supporting body cleaner 54 and is collected.

On the other hand, in the case where the control part 166 selects that a sheet is supplied from the manual bypass tray 152, the sheet stored in the manual bypass tray 152 is sent out by the pickup roll 154, is guided to the transporting passage 28, is temporarily stopped by the registration roll 32, and is guided to a place between the secondary transfer

roll 80 and the secondary transfer backup roll 72 at a suitable timing.

Besides, in the case where the control part 166 selects that a sheet is supplied from either the sheet supply unit 168 or 170, the sheet stored in either the sheet supply unit 168 or 170 is guided to the sheet transporting passage 192, is temporarily stopped by the registration roll 32, and is guided to the place between the secondary transfer roll 80 and the secondary transfer backup roll 72 at a suitable timing.

When the sheet is guided to the place between the secondary transfer roll 80 and the secondary transfer backup roll 72, the toner image primarily transferred to the intermediate transfer body 64 is secondarily transferred to the sheet by the secondary transfer roll 80 and the secondary transfer backup roll 72. After the secondary transfer, the waste toner remaining on the intermediate transfer body 64 is scraped away by the intermediate transfer body cleaner 82 and is collected. The sheet to which the toner image is transferred is guided to the fixing device 90, and the toner image is fixed through heat and pressure by the heat roll 92 and the pressure roll 94. The sheet on which the toner image is fixed is ejected to the ejection part 36 by the ejection roll 34.

Further, the preferred embodiments of the present invention are described below.

In the sheet transporting device, it is preferable that

the another sheet transporting device is a two-sided unit which reverses a sheet. Besides, it is preferable that the another sheet transporting device is a sheet supply unit for supplying a sheet. Accordingly, the two-sided unit or the sheet supply unit attached to the enclosure can be miniaturized.

In the sheet transporting device, it is preferable that the another sheet transporting device includes a sheet guide unit which guides a sheet from the enclosure. Accordingly, even if the sheet guide unit is not provided in the enclosure, when the another sheet transporting device is attached, the sheet can be guided from the enclosure to the another sheet transporting device, and the enclosure can be miniaturized.

In the image forming apparatus, it is preferable that the enclosure houses at least a fixing device for fixing a toner image to a sheet. Accordingly, even if the sheet transporting device is provided in the vicinity of the fixing device, the image forming apparatus and the sheet transporting device can be miniaturized.

In the image forming apparatus, it is preferable that the enclosure further includes a sheet ejection unit, the sheet transporting device further includes a sheet reversal ejection unit which reverses and ejects the sheet, and the sheet reversal ejection unit is more distant from the fixing device than the sheet ejection unit. Accordingly, while it is prevented that the toner image is damaged by the sheet reversal ejection unit

before the toner image is solidified and is strongly fixed to the sheet, the image forming apparatus can be miniaturized.

In the image forming apparatus, it is preferable that the sheet reversal ejection unit holds the sheet at pressure higher than the sheet ejection unit. Accordingly, since it becomes unnecessary to provide a mechanism for reversing the sheet to the sheet ejection unit in which it is unnecessary to reverse the sheet, the image forming apparatus can be miniaturized.

In the image forming apparatus, it is preferable that the sheet transporting device includes a sheet guide unit which guides the sheet from the enclosure. Accordingly, even if the sheet guide unit is not provided in the enclosure, when the sheet transporting device is attached, the sheet can be guided to the sheet transporting device from the enclosure, and the image forming apparatus can be miniaturized.

According to the invention, the sheet transporting device can be miniaturized. Besides, the image forming apparatus to which the sheet transporting device is attached can be miniaturized.

The entire disclosure of Japanese Patent Application No. 2003-337795 filed on September 29, 2003 including specification, claims, drawings and abstract is incorporated herein by reference in its entirety.